PURSUING USABLENESS AND EFFECTIVENESS IN THE DEVELOPMENT OF A SHARED PATIENT CENTERED INFORMATION SYSTEM

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ABSTRACT

Our experience supplying a shared patient centred information system is here described, pointing out some of the critical aspects underlying usableness and effectiveness.
Between and within unit integration, together with providing each professional role with added value and the special attention to adjust input and information retrieval to the actual needs (often identified only by an assiduous frequentation), has proved to be the essential point.
A study case is presented.

INTRODUCTION

As regards patient care, our Centre had been characterised for a long time by islands of automation, with little or no transfer or condivision of information from one system to another.

Purchased, internally developed and general purpose integrated packages were often used by physicians to achieve specific results.
The efforts, in terms of data entry, to support these fragmentary systems were often charged to personnel with no direct incomes. The burden of making data available to all these separate purposes was too great.
Dissatisfaction was growing.

The reasons for the failures were quite note. The problem was how to effectively impact on the clinical structure, assuring quality improvement for both patient care and daily practice.

From such an experience, it was beyond doubt that:
- the need for a centralized, comprehensive information system existed
- information sharing was critical
- it had to be a tool supporting the hospital daily activities
- maintenance must be relatively easy, semplifying the existing process

Users had become quite skilled in managing personal computers, and some important advances in networking and database management technologies occurred. This scenario made a (re)organisation feasible.
Under the care of four people of the internal group of medical informatics, a few years ago the SIO project was begun. The activities of SIO were to develop an integrated, shared patient centred information system , tailored to the basic needs of the users, while paying special attention to providing the distinct healthcare professionals with unique system functionality.
As the enterprise was - and continues to be - quite difficult, we decided to describe here our experience as a study case. Since generalisation and abstraction are often obscure, a module for a hemodialysis unit is presented to show the adopted approach in concrete form.

PRIMARY AIMS OF THE PROJECT

Most of our patients collect a long series of contacts with our structure, both hospitalisation and medical examinations, often with many tests. The generic patient is treated, inside the Centre, by many physicians, each for a specific aspect, but all of them need to know the past and present situation of the patient.
The most important aim hence is to make a complete clinical patient history available everywhere, whenever, and in the most useful form it is needed, in order to evaluate the patient condition better.
Other expectations are:
- availability of a tool for the monitoring of clinically interesting parameters
- possibility of population selections for clinical research
- time reduction of routine activities
- facilitation in supplying more exhaustive documentation , including diagnostic iter, to the general practitioner who takes care of the patient once discharged.

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GENERAL ASPECTS

One of the first questions was whether to develop the information system within the medical informatics group or to purchase it. Considering the variability of physician requirements, the support and improvement such systems require, internal development was chosen.

As regards hardware architecture, since modularity was a mandatory guide-line, the solution of a network with a database (Informix on-line) server (HP9000/827) and client PC (386xx, 4Mb) was adopted.
Windows environment was preferred both for strictly technical reasons and because of the personnel habit of using graphical interfaces (Macintosh and Windows). Powersoft Power Builder object oriented development system was also used.
In the following some critical aspects are pointed out.

Data share
As already stated [1], the principal function of a patient centred information system is the communication of information. To provide this fundamental added value, sharing a common data base is the most effective solution. Two aspectsneeded to be considered:

1- many typically divisional data had no interest for other physicians, while the outcome that the specialist draws from the data is the information needed. The efforts to achieve uniform data structure among units are often out of proportion to the potential benefits.
It seemed opportune to discriminate between public and divisional information, defining as "public" all that concerns:

- patient identification and demographic data
- anamnesis (updated, along the several contacts of the patient , with new events, and diagnosis and therapy for hospitalisation)
- outcomes

and "divisional"That which is used or collected for clinical, organisational or scientific aim of each division or unit in a division.

2- some areas, for example laboratories, often use specific software, with particular file management, and historical deepness of the archives depending only on the workload.
The only link to a clinical information system is the patient identifier. Interfacement, more then integration, may be convenient.

The system we are setting up is mainly an aggregation of integrated modules with few interfacements (with transfer into the common database of the data) to laboratory packages purchased from different vendors.

Data completeness and reliability
A patient's clinical history is written by different people in distinct moments. It is useful only if it is complete and reliable.
To achieve completeness we have carried out the following steps:

1- attribution of an event to a patient is accomplished only by personnel who either has the elements to discriminate among namesakes, or works on scheduled (pre identified) patients.

2- carrying out automatic processes to maintain the basic structures of the patient history

3- data input: up to now, generally, data are first written on paper form, and afterwards transferred to a computer. In our Centre no clerical worker is devoted to clinical data entry, with the exception of the radiology service. People, independently from the professional role, input data and information that they have personally collected or elaborated upon, and that will be at least personally useful in order to complete or more effectually perform their assigned work [2,3].

To achieve reliability, the fact that each one has to input , or at least to sign, his or her own data may be a good assurance. This can be strengthened through the use of the inputted data shortly afterwards.

Strategies of capabilities assignment are needed as in any other information system.

Interface and system behaviour
Competition with a consolidated and often well fitting daily practice and patient data organisation is sometimes difficult.
The interface and system behaviour are critical sides of the system, as regards both data entry and dialogue for information retrieval.

Two extreme, typical scenarios:
- the management of events whose frequency is high, and in which the involved information is typically predefined
- the data investigation following a free schema aimed to extemporary problems

Within the powerful and user-friendly Windows environment we have adopted, task orientation through accelerators to directly point to optimised paths has been preferred for the first case. For the second one, free navigation through the time scale and the different data structures (public and divisional) has proved to be suitable.
Moreover, other benefits in terms of usableness came from :
- designing data input screens as similar as possible to the paper form used to collect data previously.
- facilitating item selection from long lists partitioning it into a suitable number of subtypes, on the bases of both a generally accepted affinity criteria and frequency of use.
- making intensive usage of drop down list boxes.
In accordance with [4] dialogue features are: error tolerance, auto-explication, and user controllability.

Automation planning
A hospital is an aggregation of mainly data suppliers (laboratories, services) and data users (wards, clinical units); each one strictly bound to the others.
The more automation can proceed side by side, the stronger the impact and effectiveness may be. Moreover, in our opinion as in [5] , carrying out basic procedures for many users is to be preferred, especially in the early stage, postponing the additional specific options.

Software life cycle
Exhaustive interviews and group discussions on data flow diagrams with users often were not sufficient to learingall the user recording activities and the information requirements. Prototyping and subsequent use for a real patient sample are necessary tools to make users focus the system real behaviour, and evaluate the achievement of the aims.

HEMODIALYSIS SUBSYSTEM

Context
Generally , a patient arrives at the hemodialysis unit after, at least, one hospitalisation and subsequent discharge, and keeps on being subjected to hemodialytic therapy,on average, three times a week, until transplant or other events occurs. From that time on, the patient is charged to the physicians of the unit for any clinical problem.

Dialytic population is divided into 4 groups, as 2 shift of sessions a day are performed. Nurses, technicians and physicians work on shifts respectively to administer the 4-hour dialytic therapy and manage the patients, to prepare the machines, to evaluate patient state, and consequently balance the treatment.

Mainly nurses are interested in what may happen during a session, while the physician looks at several sessions, together with lab tests, to draw a trend and to produce, monthly, a synthesis.

All the other clinical problems that may arise are worked out concurrently. Often hospitalisation and other events occur during the dialytic life of a patient.

The system
According to the discrimination stated above, the patient is known to the system , and the following information are available to the physician accepting the patient inside the unit:

private data:	name, date of birth, address, etc.
anamnesis:	it is composed of - the history told by the patient himself at the admission to the ward - the reason for the hospitalisation - the diagnosis and the therapy at the discharge from the ward (this is due to the fact that the outcome of an hospitalisation is necessary the anamnestic connection for any following contact)
outcomes:	typically textual reports of diagnostic test and data from lab tests collected during the hospitalisation

Divisional data (in this case ward data) such as hospitalisation length, particular classifications of the patient, etc. are not generally available .

Within the unit other departmental information is needed (mainly structured):

patient-bound: - clinical, such as specific coded diagnosis, risk factors, vascular access, etc.
- aimed to patient management such as shift, conveyance, etc.

pharmacological and substitutive treatment-bound: types of treatment, characteristic of treatment as filter, optimal session duration , dry weight, therapy, etc.

While the first group of information is quite steady, the treatment-bound ones are variable and have historical value.

Once the treatment is started, session-bound information, treatment changes, and lab tests continue to be collected . This is the information core on which the patient care is performed.

For each session the patient's sheet is printed (fig.1). It is composed of two sections.

The right one (B) refers to the current session and represents the data collection form. Shaded fields are the ones subjected to input by an identical mask. It is used by the nurse to record physiological parameters such as blood pressure, weight, heart rate, symptoms (at every hour of the session), and technical information such as types of the needles used and the presence of difficulties connected to the vascular access, etc. The session sheet is used by the physician too (during rounds), to notify treatment changes and the need of extemporary controls. As physicians, and also nurses, alternate in taking care of the patient, continuity must be assured.

The bottom most part of (B) is aimed at communication of clinical notes: the last recorded ones are listed to let anyone know the recent past conditions and to make the patient realise that his situation is under control, independently from the person whom he has spoken with.

The left section (A) refers to the previous 6 sessions

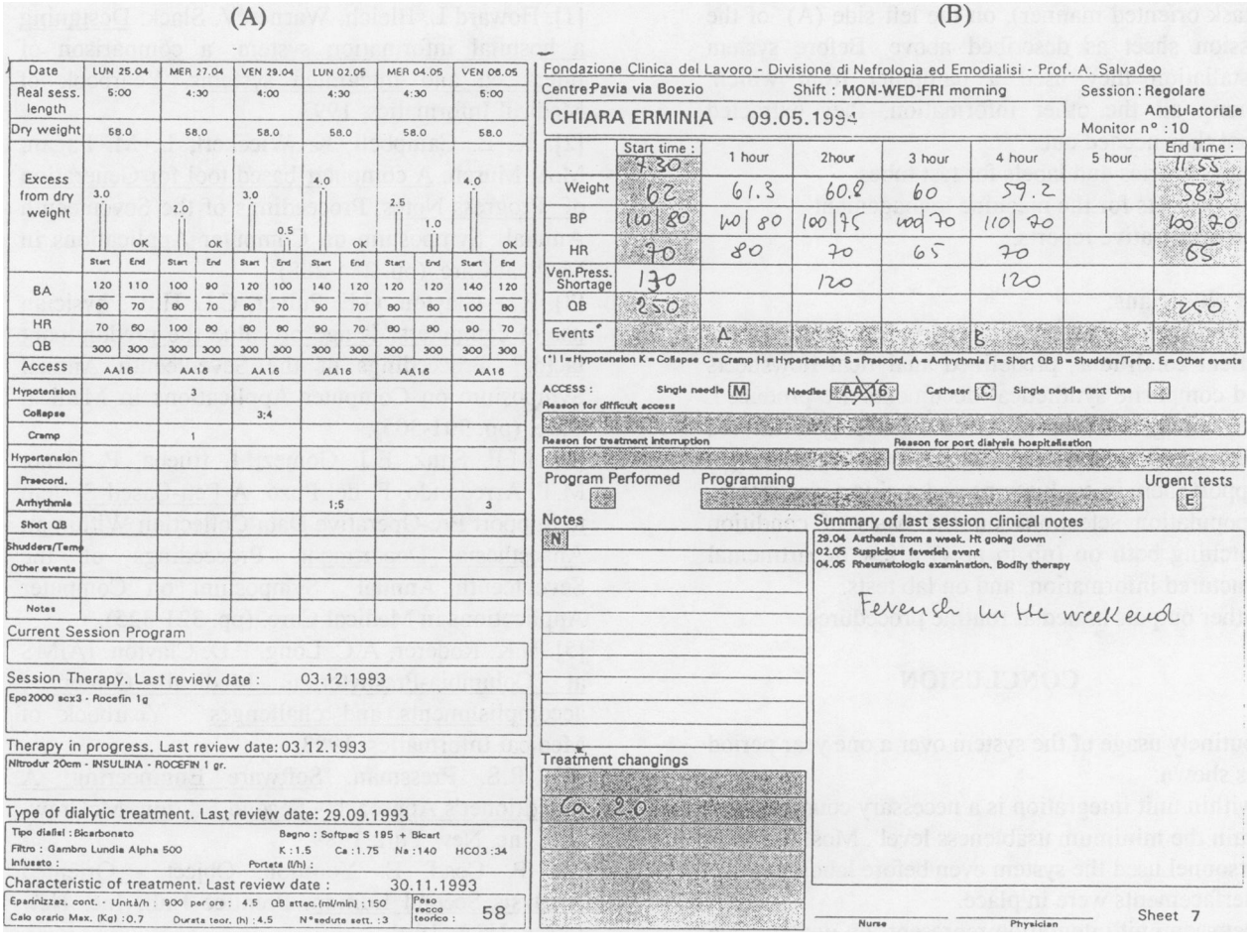

Fig. 1 : Session sheet.

and to the present type and characteristics of the treatment. It is used mainly by nurses to compare the present session course with the previous ones, in terms of parameter values, occurrence of symptoms and access modality and by the physician to balance substitutive treatment and therapy on the basis of the previous weeks. The inspection of the recorded data 2 days after the input, has resulted in a certain amount of corrections.

Automatic order entries for lab tests are available. The data from laboratories come back to be merged together with other information specifying the particular circumstance in which withdrawal has been performed (i.e. pre or post dialysis). Periodical evaluation of data draws to a textual synthesis automatically updating the patient anamnestic history.

Output/added value

For nurses:

- faced with the input of at most 22 data pointsper patient (meanly a 2 minute per patient operation in a task oriented manner), on the left side (A) of the session sheet as described above. Before system installation they used a pamphlet from which, among all the other information, they extracted what they needed out
- order entries and labels for test tubes
- worksheets for the machine management
- administrative reports.

For physicians:

- faced with a variable data entry, depending on the patient conditions, predefined analytical flowsheets and composite synthetical documents are produced. Free navigation lets physicians investigate all the other public and departmental information to support them in evaluations and making decisions
- population selections on the basis of condition matching both on (up to now) a few departmental structured information, and on lab tests.
- other outputs aimed at routine procedures.

CONCLUSION

Routinely usage of the system over a one year period has shown:

- within unit integration is a necessary condition to attain the minimum usableness level . Most the personnel used the system even before laboratory interfacements were in place.
- between unit integration represents an unavoidable step to prevent from dangerous, partially manual and partially automated, compromise solutions that could bring back to a fragmentary situation.
- tuning of the system on the real needs underlying a consolidated daily practice is obtainable only through the real usage of the system and assiduous frequentation of the clinical units. Session sheet composition and layout have been modified many times to let personnel use it as the only tool to carry out session activities.
- when data input continuity is mandatory, time relief in routine activities may become a sufficient condition to assure data completeness. Nurses , whom most of the daily input effort is charged to, do not complain of being overburdened.

Moreover, as the development of the entire system is on going , we remember that a focus on achieving a high level of usableness may force us to spend time for improvements that are not sometimes proportionally appreciated.

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